

Quartz synthesizer

FM STEREO TUNER

F-28

OPERATING INSTRUCTIONS

S/G



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F-28 is designed to operate from 110V, 120V, 220V or 240V main. Before turning on the power, please confirm the line voltage setting indicated on the rear of your unit corresponds to the supply voltage in your area; if not, change the setting as described in **IMPORTANT-LINE VOLTAGE** on page 11.

 PIONEER®

FEATURES

Quartz Synthesizer Tuner

The F-28 FM Synthesizer Tuner features a photo sensor which reads out the reception frequencies which are encoded on the dial scale and also a quartz synthesizer which controls the local oscillation frequency by means of the built-in quartz oscillator.

The tuner is capable of receiving a total of 103 broadcasting stations which have been quartz-locked in 200kHz steps ranging from 87.5MHz to 107.9MHz using the light signals which pass through the binary code (8-bit) pattern corresponding to the reception frequencies on the dial scale. The exciting thing about this system is that there are no tuning deviations triggered by fluctuations in the ambient temperature or humidity, and also that there are no dial scale deviations since the dial scale and the code pattern are fixed. All in all, these features make for an extremely accurate type of tuning system.

Five-gang Variable Capacitor in the RF Amplifier Stage

The F-28 adopts a dual-stage RF amplifier-stage front end which employs a high-precision 5-gang variable capacitor and 3 dual-gate MOS FETs which have already been applauded by critics on account of their high-gain and low-noise characteristics. Between the RF amplifier-stages is a double tuned circuit configured by a capacity coupling and also an M-type coupling. This circuit helps to enhance the tuner's immunity to interference and also contributes to some sparkling characteristics: an IHF sensitivity of 10.3dBf, a spurious response ratio of more than 120dB and an image response ratio of more than 120dB.

Intermediate Frequency Amplifier that Permits a Choice of Bandwidth

The F-28 incorporates an intermediate frequency amplifier with a 2-stage switchover capability for selection between NARROW (narrow band) with its high selectivity and WIDE (wide band) with its high degree of fidelity to the signals. This feature is engineered for the best in sound quality. The WIDE system employs a dual-element ceramic filter with superb phase characteristics (group-delay-time flatness characteristics) for a surprisingly low distortion factor, whereas the NARROW system employs a wide filter plus 3-element ceramic filters to achieve an effective sensitivity of 65dB (300kHz). This means that even if there is a station broadcasting and transmitting a high level of interference in the immediate vicinity of the station you want to tune into, the F-28 will not pick up the interference and yet still provide reception with a good signal-to-noise ratio.

PBL Detector for High S/N and Low Distortion

In order to attain a "magni-wide" (super-wide) range, Pioneer has developed the PBL (parallel balanced linear) detector. This is an improved version of the ultra-wide-band linear detector which features an amazingly high detection efficiency. This brainchild is your guarantee that there will be no ageing and that the F-28 will always operate stably and provide you with a "magni-wide" band.

PLL MPX IC with Built-in Auto Pilot Canceller

The MPX section incorporates a clean pilot system that enhances not only the high-frequency distortion rate but also the channel separation. What it does is to effectively cancel out the undesirable signal components (called "jitter") which are generated by the FM stereo broadcasting pilot signal and modulation signal beats. This is backed up by the 19kHz pilot signal automatic canceller circuit designed to improve the high-range frequency response even further, and other highly advanced techniques. These guarantee a signal-to-noise ratio of 81dB (IHF stereo), a distortion of 0.05% (1kHz) and 0.15% (10kHz stereo), and a number of other stunning figures.

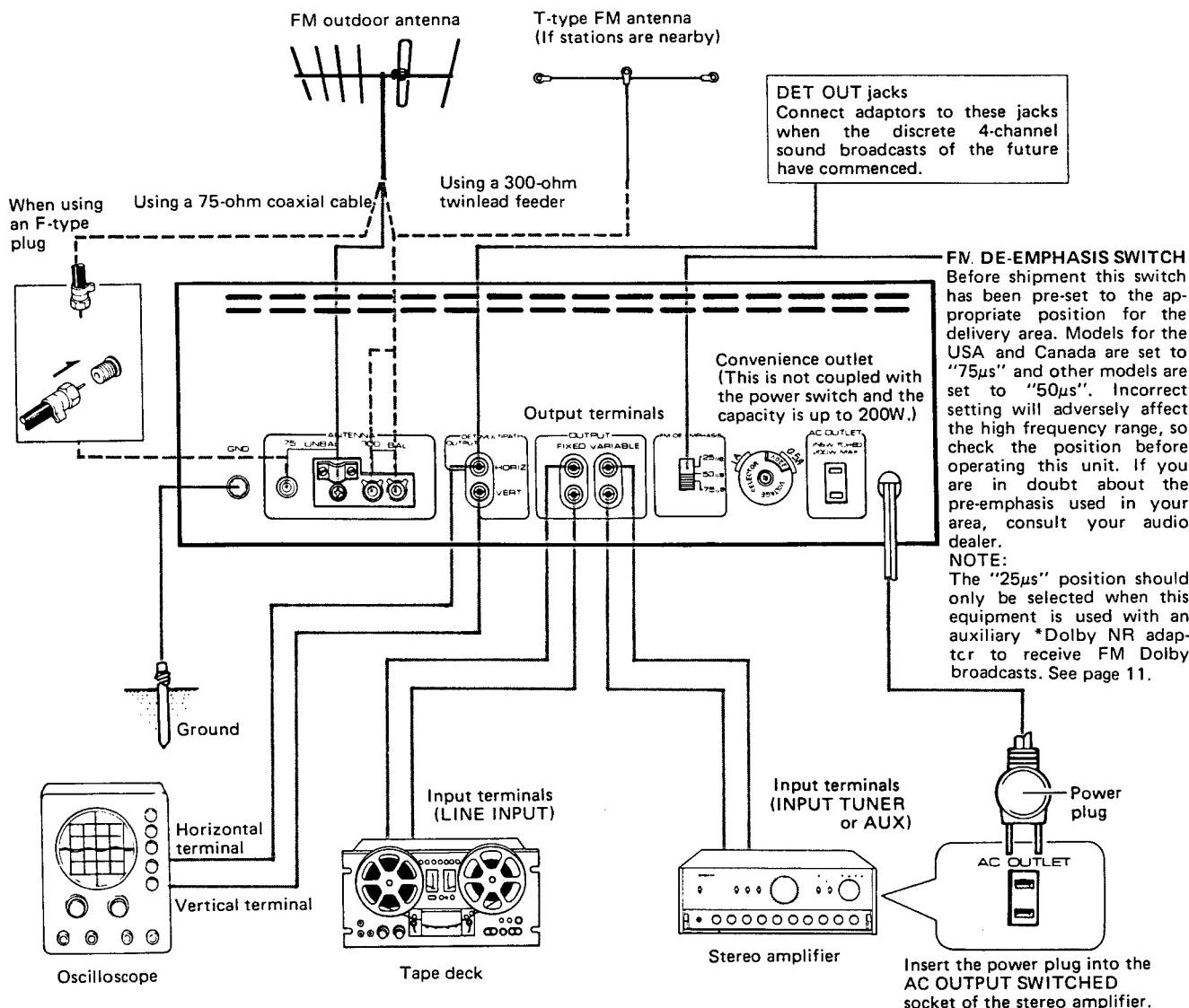
Signal Meter which Enables Field Strength to be Read out Directly

It is possible to read out the input field of radio waves arriving at the tuner up to a maximum of 100dBf. This is further supplemented by the signal system IF which refers to the IF circuit in the control system that Pioneer specially built into the meter circuit separately. The AGC is applied to the input signals and the meter pointer deflects linearly, thereby enabling high input levels of 100dBf to be read out accurately.

Superb Operational Ease that Reflects Highest Performance

Pioneer has done away with the usual push-button switches on the front panel of its F-28, and in their place it has employed "key switches" and "digital ICs" to configure touch switches whose positions can be selected electronically. When the key switches are pressed lightly, the power is supplied, or alternatively switched off, to each of the sections by the flip-flop IC circuit. These mechanisms create a new sensation in operation.

CONNECTION DIAGRAM



INSTALLATION PRECAUTIONS

To ensure a long and reliable performance, avoid installing the F-28 in any of the following locations:

Locations to be avoided	Possible detrimental effects
<ol style="list-style-type: none"> Locations exposed to the sun or heat radiated by heaters, on top of heat-generating power amplifiers, near power transformers. Locations which are not properly ventilated, and locations with a high humidity or moisture content. Do not place vases or goldfish bowls on top of the tuner. Locations where there are alcohol, benzine and other volatile chemicals in the vicinity. Take care not to bring sprays like insecticides near the tuner. 	<ol style="list-style-type: none"> External heating can cause the circuit components to deteriorate and it may prevent stable operation. Humidity and moisture can cause defective insulation, and adversely affect the performance of the precision circuit components. Chemicals can corrode the panels and chassis and change their coloring.

CONNECTIONS

CONNECTIONS TO A STEREO AMPLIFIER

Use the accessory pin plug connecting cords to connect the TUNER or AUX jacks of the stereo amplifier with the OUTPUT VARIABLE jacks of the tuner.

CONNECTIONS TO A TAPE DECK

You will be able to record FM broadcasts if you connect a tape deck directly to the tuner. Simply use the accessory connecting cords provided with the tape deck to link up the recording input (LINE INPUT) jacks of the tape deck with the OUTPUT FIXED jacks of the tuner.

The output level of the FIXED jacks cannot be adjusted.

Connection Precautions

- The tuner's OUTPUT jacks as well as the connecting jacks on the stereo amplifier and tape deck come in sets of two, one being for the left (L) channel and the other for the right (R) channel. Make sure that you connect L to L and R to R correctly.
- Plug the connecting cords firmly into the jacks; loose connections can generate noise.
- Do not bundle the input and output cords with the power and speaker cords. Also avoid using cords which are longer than required and bunching them. These practices can result in noise, impaired sound quality, and possible operating difficulties.

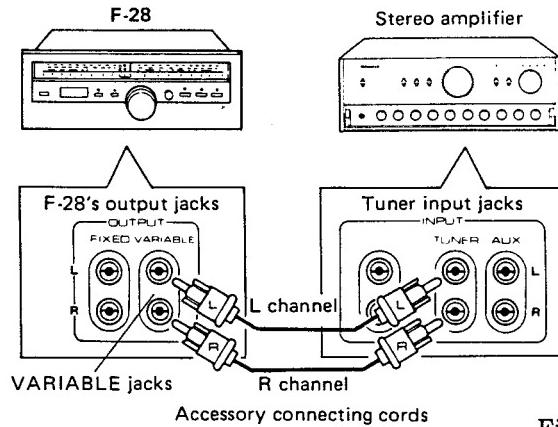


Fig. 1

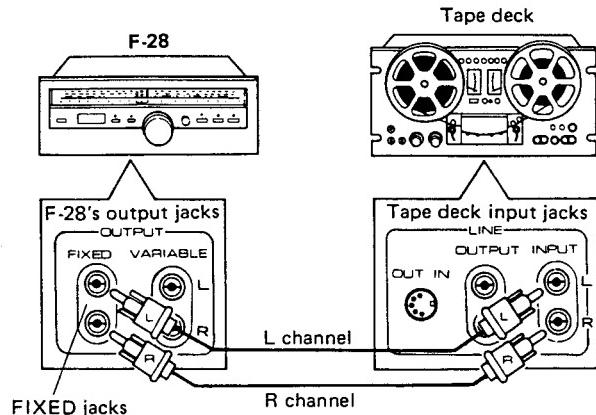


Fig. 2

ANTENNA AND GROUND CONNECTIONS

There are two methods you can use when connecting the FM antenna to the antenna input terminals: you can use a 300-ohm twinlead feeder or a 75-ohm coaxial cable.

Pioneer recommends the 75-ohm coaxial cable (RG59U, etc.) if you want your tuner to display its capabilities to the full. The coaxial cable is more effective than the twinlead feeder in safeguarding against external interference noise from impairing the sound quality. In other words, twinlead feeders are liable to pick up external noise, and this is why they are not recommended.

If you have installed your FM antenna outdoors, follow the instructions mentioned on page 5 and connect the antenna to antenna terminals, and ground lead to GND terminal. When newly installing your antenna, refer to "INSTALLING THE FM ANTENNA" on page 6.

CONNECTIONS USING A 75-OHM COAXIAL CABLE

When connecting, you can choose between directly securing the cable to the antenna input terminals and using an F-type connector. Decide which method to employ in accordance with the type of coaxial cable you intend to use. The accessory F-type plug is for use only with the RG59U coaxial cable. For all other coaxial cables, use the optional F-type plug or secure the cable directly to the input terminals.

Directly connecting the cable to the antenna input terminal: Refer to Fig. 3 and follow the procedure. Prepare the tip of the coaxial cable and connect it to the antenna input terminal (75Ω -UNBAL).

Connections using the F-type connector: Refer to Fig. 4 and follow the procedure. Prepare the end of the coaxial cable and attach the accessory F-type plug.

CONNECTIONS USING A 300-OHM TWINLEAD FEEDER

In cases where it is only possible to use a twinlead feeder with a community receiving system antenna, refer to Fig. 5 and follow the procedure. Prepare the ends of the twinlead feeder and attach them to the 300Ω -BAL antenna input terminals. Then make the twinlead feeder as short as possible but do not bundle the wires or run them loose on the floor.

ACCESSORY T-TYPE ANTENNA

This antenna is designed to allow you to receive FM programs in areas where strong signals are beamed by broadcasting stations until you install your FM antenna. As shown in Fig. 5, attach the antenna to the 300Ω -BAL antenna input terminals and then tune into an FM station, following the instructions listed under "LISTENING TO BROADCASTS" on page 9. Extend both ends of the antenna horizontally, locate the optimum receiving location by moving the antenna to the left or right, or up or down, and then secure it to the ceiling or wall.

GROUNDING

From the viewpoint of both safety and reduced noise, Pioneer recommends that you employ a ground as shown in Fig. 5. Connect the ground lead to the GND terminal of the F-28. Never connect it to a gas pipe or other dangerous location.

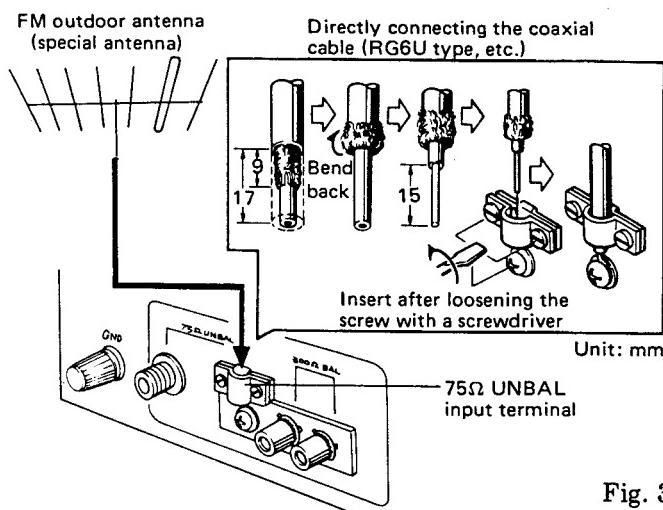


Fig. 3

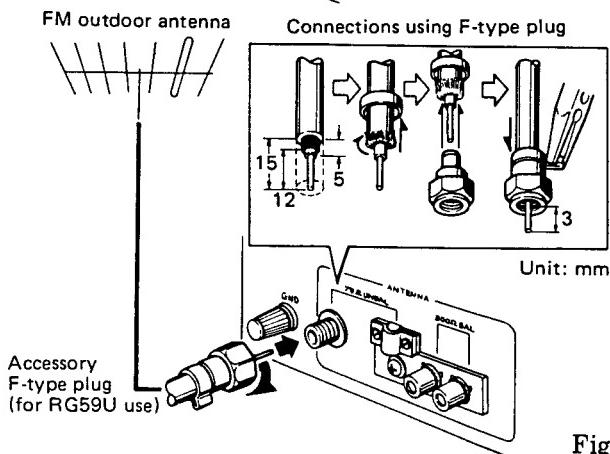


Fig. 4

NOTES:

- When using the F-type plug, make sure that the wire has a single strand, and choose a wire with a strong shield.
- When connecting, take sufficient care so that you do not short the outer shield wire and the inner strand.

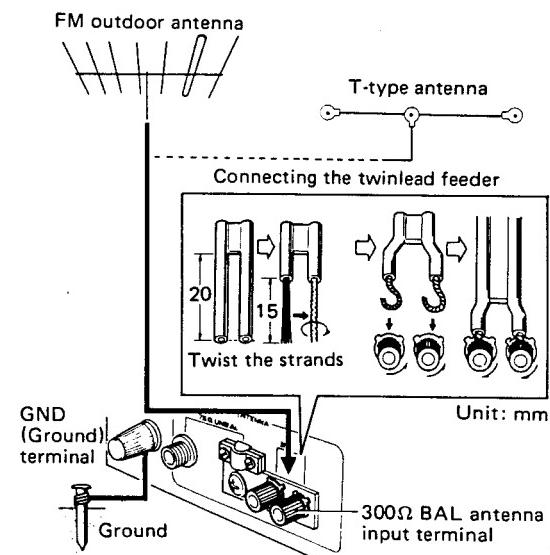


Fig. 5

INSTALLING THE FM ANTENNA

It is necessary to choose the installation location for the FM antenna prudently so that you will be able to receive FM stereo broadcasts with both optimum stability and sound quality.

Bear in mind the items below, and then find the best location (height and direction).

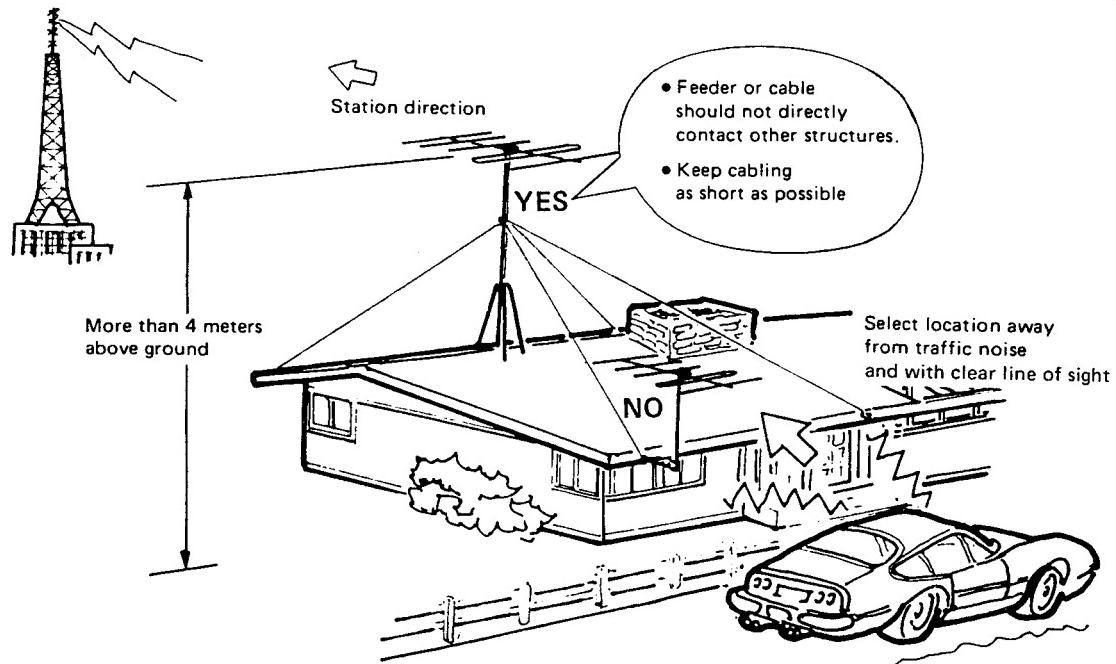
1. The ideal place for the antenna is somewhere where it will pick up the signals directly from the transmitting antenna of the FM broadcasting station. If you install the antenna between high-rise blocks or on the other side of buildings or similar obstacles where it will not be able to pick up the signals directly, you will find that multipath distortion is caused by the effects of the reflected radio waves bouncing off those obstacles. This means that the channel separation is sometimes impaired.

Refer to the sections on page 7 on "multipath distortion detection and adjustments", and choose a height and direction for the antenna where the effects of multipath distortion are minimal.

2. Install your antenna as far away as possible from roads and highways so the ignition noise of automobiles will not interfere with reception. Also, set your antenna at a distance from high-tension power transmission lines and neon signs.

3. Install the antenna at a distance of not less than 2 meters from a metal roof, concrete buildings, and TV antennas.

SETTING UP AN FM ANTENNA



FM MULTIPATH DISTORTION

Multipath distortion occurs when FM signals are reflected by mountains, buildings and other obstacles lying in the path of the signals and enter the antenna from various directions, as shown in the accompanying figure. Due to the different distances travelled by the reflected signals, the slight time difference with which they strike the antenna causes mutual interference. This results in phase distortion, distortion of the received sound, reduced channel separation, and a downgraded signal-to-noise ratio. The tuner is liable to be affected by this phenomenon when the radio waves are weak.

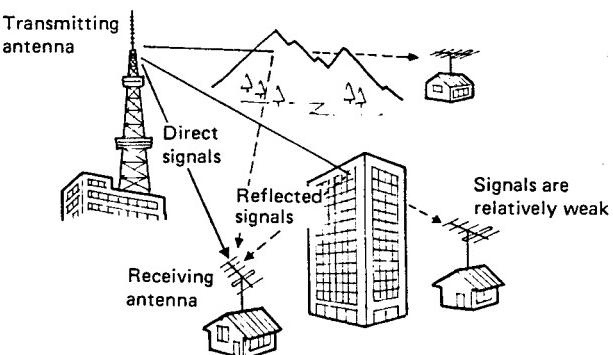


Fig. 6

MULTIPATH DISTORTION DETECTION AND ADJUSTMENT

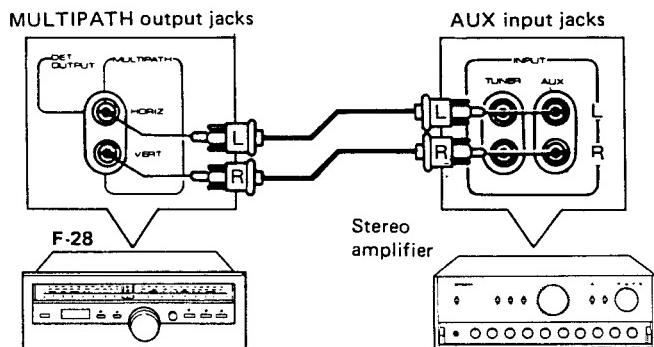
Just like when erecting a FM antenna, it is very difficult to choose the right direction for optimum reception by yourself. Get somebody to give you a hand and perform the following adjustments.

Adjustments when using a stereo amplifier

1. As shown in Fig. 7, connect "HORIZ" (Horizontal) MULTIPATH output jack of the F-28 to the AUX input L (left) channel jack of the stereo amplifier, and "VERT" (Vertical) MULTIPATH output jack to the AUX input R (right) channel jack.
2. Set the FUNCTION switch TO AUX of the stereo amplifier.
3. Turn down the volume of both stereo amplifier channels and tune into an FM station. Next, increase the volume a little at a time. Through the left channel will be heard the sound of signals with an accentuated treble, while through the right channel will be heard the multipath distortion noise (AM components formed by the reflected radio waves).
4. Turn down the sound of the left channel using the stereo amplifier's balance control, and adjust the direction of the antenna so that the multipath distortion is reduced to the minimum, all the while listening to the sound through the right channel.

Adjustments when using an oscilloscope

1. As shown in Fig. 8, connect the HORIZ MULTIPATH output jack at the rear of the tuner to the HORIZ axis input jack on the oscilloscope and the VERT MULTIPATH output jack to the VERT axis input jack with good quality shielded wires.
2. Tune into an FM station so that the tuner is perfectly tuned.
3. Adjust the oscilloscope controls and observe the wave-forms.
4. The multipath wave-forms appear in a number of differing patterns in accordance with the height and direction of the antenna and with the strength of the radio waves. In addition, they are undergoing variations all the time due to the strength of the audio signals. The waveforms illustrated in Photo A of Fig. 9 are an example of what you can expect to observe when the multipath distortion is relatively high. In order to reduce the multipath distortion, adjust the height and direction of the antenna so that the patterns become linear (see Photo B of Fig. 9).



The multipath distortion can be heard through the right-hand speaker.

Fig. 7

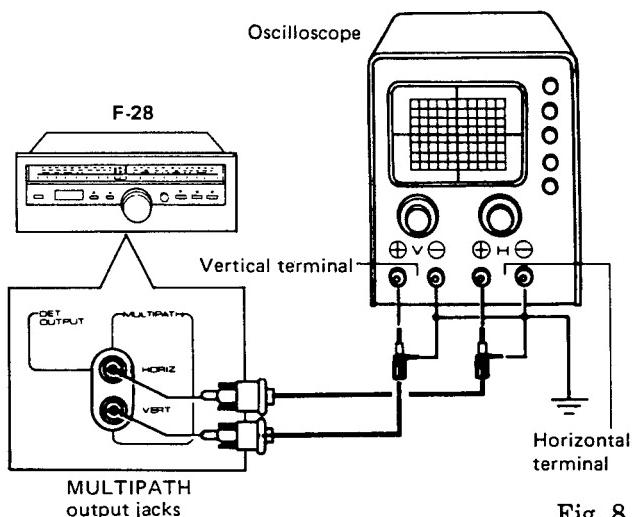


Fig. 8

Photo A: a high level of multipath distortion.

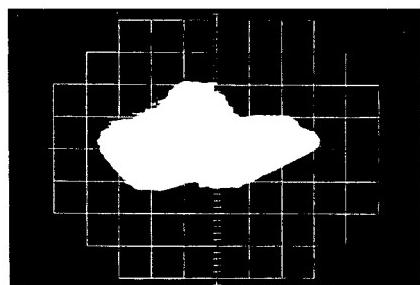


Photo B: no multipath distortion.

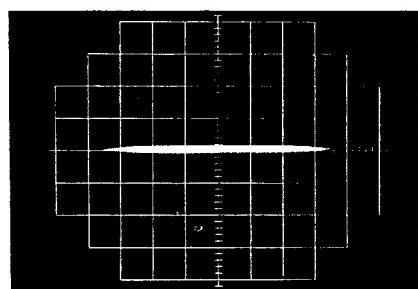


Fig. 9

FRONT PANEL FACILITIES

POWER SWITCH

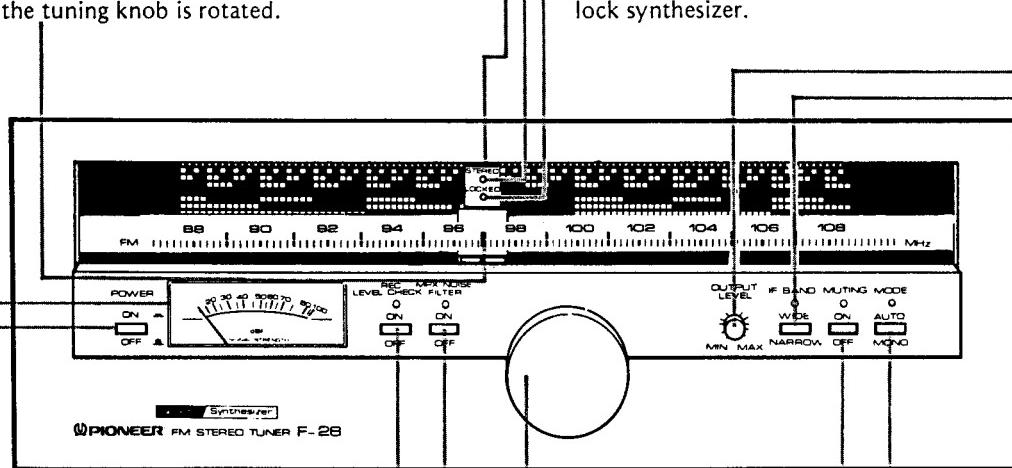
Use this switch to turn the power to the tuner on and off. Push the switch and the power will come on. The dial scale and the meter will also light up. As soon as the POWER switch is set to ON, the IF BAND, MUTING and MODE switches are set to WIDE, ON and AUTO, respectively.

SIGNAL METER

This meter indicates the strength of the antenna input field level of the broadcast signals in dBf units. The pointer will deflect more to the right as the input level increases. When tuning in a station, the meter pointer will deflect to the far right and it will then stop at that place where the station indicator lights up.

STATION INDICATOR

This indicator lights up every 200kHz as the pointer moves when the tuning knob is rotated.



REC LEVEL CHECK SWITCH

When this switch is set to ON, and the indicator lights up 330Hz signals (a level which is equivalent to 50% FM modulation) are made continuously available. Use this switch to set the recording level of the tape deck. For further details, refer to "REC LEVEL CHECK SWITCH" on page 10.

MPX NOISE FILTER SWITCH

Set this switch to ON (and the indicator lights up) while you are listening to a program if you are bothered by relatively high frequency noise.

TUNING KNOB

Use this knob to tune in the FM stations. Watch the SIGNAL meter pointer, rotate the tuning knob and select a station.

POINTER

As with ordinary pointers, this pointer will move along the dial scale when the tuning knob is rotated and the desired station selected. The pointer is provided with a built-in STEREO indicator, LOCKED indicator and station indicator, and it also self-contains the code pattern readout mechanism.

STEREO INDICATOR

This indicator lights up when the tuner is receiving a stereo program if the MODE switch is set to AUTO.

LOCKED INDICATOR

This indicator will light up when the pointer reaches the optimum tuning position for a broadcasting station. It indicates that the frequency of the broadcasting station has been locked by the actuation of the built-in quartz lock synthesizer.

MODE SWITCH

This switch is set to AUTO as soon as the POWER switch is set to ON, and the indicator lights up. Keep this switch at this position when receiving FM programs in stereo.

MUTING SWITCH

This switch is set to ON as soon as the POWER switch is set to ON, and the indicator lights up. There will now be no unpleasant interstation noise heard when selecting stations. Set this switch to OFF by pushing it lightly in areas where the signals are extremely weak.

LISTENING TO BROADCASTS

OUTPUT LEVEL KNOB

This knob is used to adjust the output level of the VARIABLE (OUTPUT) jacks. When it is rotated in the direction of MAX, the output level is increased. For further details, refer to "OUTPUT LEVEL KNOB" on page 10.

IF BAND SWITCH

This switch is used to select between WIDE (wide band) and NARROW (narrow band). In this way, it is possible to change over the pass bandwidth of the intermediate frequency signals.

This switch is set to WIDE as soon as the POWER switch is set to ON, and the indicator lights up.

If the switch is already set to WIDE and there is interference from neighboring broadcasting stations, push it lightly and set it to NARROW. The indicator will go off and the switch will be set to NARROW.

For further details, refer to "IF BAND SWITCH" on page 10.

1. Set the POWER switch to ON.
 2. Rotate the tuning knob and tune in to the station whose program you want to listen to.
 3. The SIGNAL meter pointer will deflect to the far right when the pointer reaches the optimum tuning point. Also, the LOCKED indicator attached to the pointer will light up to indicate that the pointer is locked to the frequency of the broadcasting station.
- When the program is being broadcast in stereo, the STEREO indicator will also light up.
 - The LOCKED indicator will not light up even if the pointer is locked to the frequency of a station when the field strength is extremely weak (less than 19.2dBf).
- In cases like this, you will be able to receive the program if you set the MUTING switch to OFF.

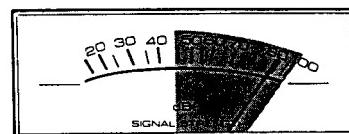
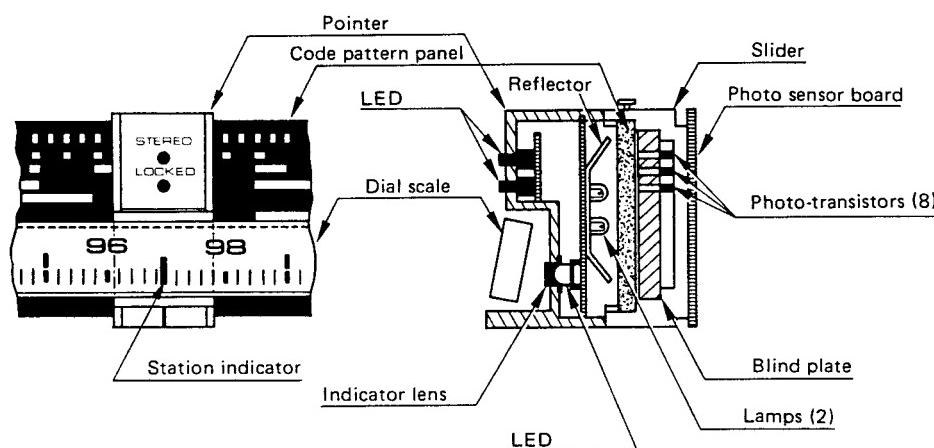


Fig. 10

THE TUNING SYSTEM

When the tuning knob is rotated, the pointer and slider in the figures slide over the code pattern panel. By means of the lamp and reflector which are incorporated into the pointer, light passes through the holes in the code pattern panel and the blind plate to reach the photo transistors. These

read out the reception frequency which has been selected, the oscillation frequency of the front end is determined by the actuation of the quartz synthesizer, and the pointer is locked to the optimum tuning frequency.



ACCESSORY FUNCTIONS

MUTING SWITCH

When you are rotating the tuning knob to select a station, you will hear an unpleasant hissing noise between stations. The muting circuit serves to cancel out this noise and make tuning more enjoyable.

- Set this switch to ON if the broadcasting station is located relatively nearby.
- When the broadcasting station is distant and the signals are extremely weak, set this switch to OFF. The noise will increase but then you will be able to tune in broadcasting stations whose signals are weak.

IF BAND SWITCH

Pioneer approached the design and construction of this tuner from the viewpoint that "performance must come first." That is why the pass signal band width of the intermediate frequency amplification circuit is set to WIDE as soon as the POWER switch is set to ON. In the event that there are broadcasting stations with a strong field in the vicinity of the station you want to tune into, set this switch to NARROW and you will then be able to receive the signals without interference in a narrow band of 65dB (300kHz).

OUTPUT LEVEL KNOB

The F-28 is provided with VARIABLE OUTPUT jacks whose output level can be varied by adjusting the OUTPUT LEVEL knob on the front panel, and also FIXED OUTPUT jacks whose output level is fixed.

Using the VARIABLE jacks

The output level can be adjusted using the OUTPUT LEVEL knob, thereby making it possible to bring the output levels of the F-28 and of the other components connected to the stereo amplifier (such as a turntable or tape deck) in line with each other.

REC LEVEL CHECK SWITCH

The recording level must be set correctly for good quality FM broadcast recordings. However, it is no easy task to set this level since the output level of an FM broadcast is fluctuating all the time.

By setting the REC LEVEL CHECK switch to ON, it is possible to make available 330Hz reference signals at a level which is equivalent to a 50% FM modulation. This means that it is possible to set the recording level optimally, irrespective of the program being received.

Setting the recording level

1. Connect the tape deck (see page 3).
2. Operate the tape deck and set to the recording standby mode.
3. Set the REC LEVEL CHECK switch to ON, and 330Hz signals will now be fed out continuously at the OUTPUT (both FIXED and VARIABLE) jacks.
4. Adjust the recording level of the tape deck so that the recording-level meter pointers deflect within the following ranges:
 - 0 to +2dB with an open-reel deck
 - About -2dB with a cassette deck
5. Tune in to the desired FM station and start recording after you have set the REC LEVEL CHECK switch to OFF.

The output level of the signals is the same for both left and right channels, and so these signals can be used as reference signals to adjust the left/right channel volume balance of a stereo system connected to the OUTPUT jacks.

FM-DOLBY RECEPTION

The FM DE-EMPHASIS switch is provided to allow reception of FM-Dolby broadcasts in locations where these programs are being transmitted. A separately sold adaptor must be connected to the stereo amplifier in this case, then proceed according to the following steps:

1. As shown in Fig. 11, connect the Dolby NR adaptor to the tape (record & play) jacks of the stereo amplifier.
2. Set the rear panel FM DE-EMPHASIS switch to $25\mu s$.
3. Set the TAPE MONITOR switch of the stereo amplifier to ON.
4. Set the FUNCTION switch to the FM position and use the TUNING knob to tune in to an FM-Dolby broadcast. Tuning is performed in the same manner as described in "LISTENING TO BROADCASTS."
5. Operate the adaptor and set for reception. Adjust the volume and tone with the controls of the stereo amplifier.

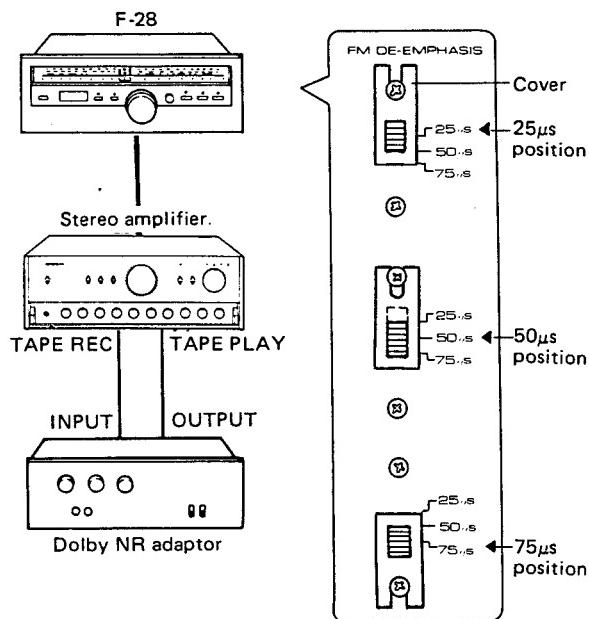


Fig. 11

FM DE-EMPHASIS SWITCH

1. Loosen the upper screw, remove the plastic cover and set the switch to $25\mu s$.
2. Loosen the lower screw, rotate the plastic cover 180° .
3. Finally, tighten the two screws to secure it.

NOTES:

- Refer to the Dolby NR adaptor operating instructions regarding connection and operation.
- When not listening to FM-Dolby broadcasts, be sure to set the FM DE-EMPHASIS switch to $50\mu s$ or $75\mu s$.

IMPORTANT—LINE VOLTAGE

Before using this unit, be sure that the rear panel line voltage selector switch has been set to match your household AC power line voltage. If necessary to change the switch setting, proceed according to the steps below.

1. Disconnect the A.C. mains cord.
2. Use Phillips screwdriver to unscrew fuse cap, then take out fuse and SELECTOR plug (Fig. 12).
3. Reinstall the SELECTOR plug so that its cut out section exposes the voltage indication of the SELECTOR socket which corresponds to your household AC power line.
4. Refer to table and install replacement fuse (provided as accessory).
5. Insert fuse in fuse cap, then install cap to plug and tighten.

TABLE

VOLTAGE	FUSE
110V, 120V	1A
220V, 240V	0.5A

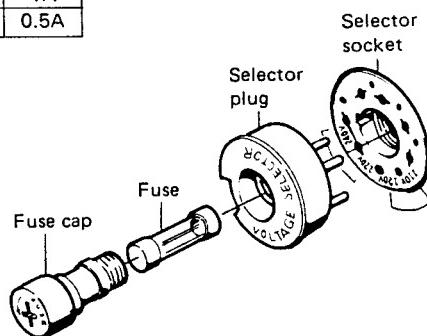


Fig. 12

PRINCIPLE OF OPERATION

The F-28 is a high-performance and high-stability FM synthesizer tuner which makes the most of its analog and digital circuitry. A brief explanation of the control functions in the local oscillator circuit of the front end, the heart of the tuner, now follows.

Basically, a phase-locked loop (PLL) system is featured composed of a reference oscillator which uses a high-accuracy quartz oscillator. The reception frequencies are encoded by means of the code pattern coupled directly to the dial scale, and a function is added that controls the local oscillation frequency accurately.

Given below is the block diagram relating to the tuner's operation. The quartz oscillator generates a constant frequency of about 10MHz. This is demultiplied (by a factor of 1000) to become the reference frequency (10kHz), after which it is applied to the phase comparator. The other signals are now multiplied and sent to the mixer where they are mixed with the signals of the local oscillator.

The difference between the frequencies of the two signals is taken out, this frequency is demultiplied and sent to frequency divider N.

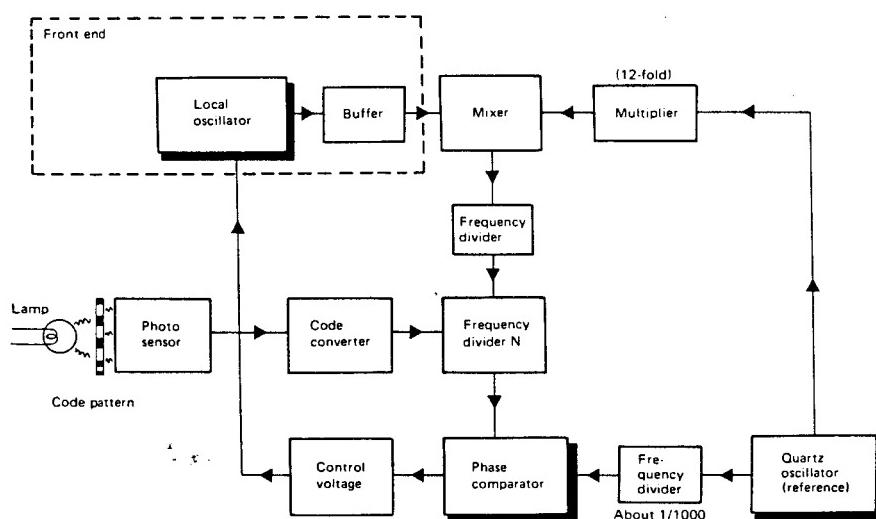
When a desired station is tuned in on the dial, the photo sensor are actuated by the light signals which have passed through the code pattern, and these are converted into a code corresponding to the reception frequency. This code determines the number (N) of frequency divisions of frequency divider N. This triggers the frequency demultiplication of the signals sent from the mixer, the signals are given a frequency of about 10kHz and they are then applied to the phase comparator.

The phase comparator serves to compare the signals of the local oscillator which have been N-demultiplied with the reference signals from the quartz oscillator. If both signals have the same frequency, the reception frequency on the dial is picked up correctly. If there is a slight difference between them, however, it means that the frequency which has passed through the frequency divider N is distorted. The phase comparator generates a signal that corresponds to this difference. This is sent to the control voltage circuit, and the oscillation frequency of the local oscillator is controlled to the correct value by the above signal that serves as DC control voltage.

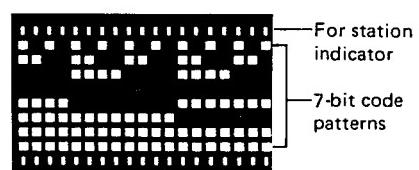
The code pattern of the photo sensor indicates that the station indicator, that indicates the reception frequency on the dial as per the figure, has come on and that the synthesizer is actuated. The code patterns express the reception frequency in code. These are divided every 200kHz for a total of 103 codes. This means that all the FM stations are encoded and can therefore be received.

Frequency divider N is a circuit designed to keep the local oscillation frequency that corresponds to the 103 different signals constant at all times, and numerical values corresponding to these stations are obtained under the encoding. With this system, the signals sent via the frequency divider from the mixer have their frequencies demultiplied to a constant 10kHz by frequency divider N.

A synthesizer tuner is a sophisticated automatic control type of tuner which applies composite frequency techniques.



CODE PATTERN PANEL



CONDITIONS FREQUENTLY MISTAKEN FOR MALFUNCTION

If the F-28 is not displaying its usual tip-top performance on account of the poor sound level or a great deal of noise, check the points listed below:

- Sound is not heard: Check the connections and operation procedure again, referring to the "Operating Instructions."

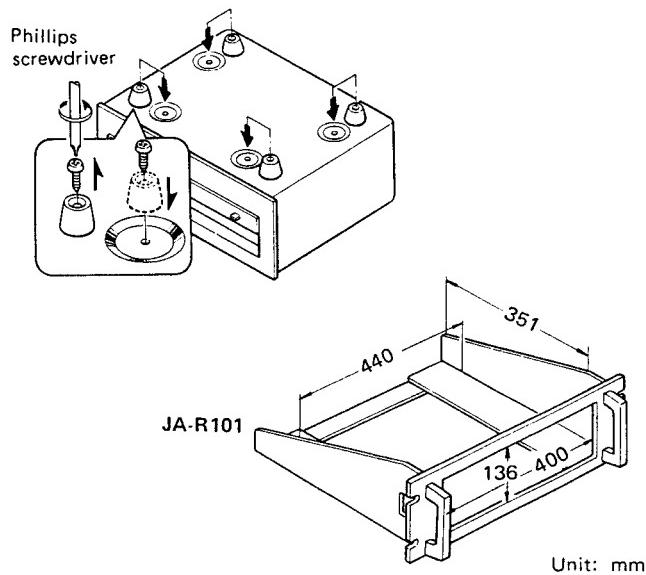
- Great deal of noise: Referring to the table below, diagnose and remedy the symptoms.

If you find it difficult to analyze the source of the noise, get in touch with your nearest Pioneer After-Service Center or Service Station.

SYMPTOM	SUSPECTED SOURCE OF NOISE	DIAGNOSIS AND REMEDY
When you start to receive a broadcast, there is a continuous or intermittent noise like "jjjjj" or "zzzzz", the IF WIDE indicator goes off and the IF band is set to "narrow."	<ul style="list-style-type: none"> • Static or lightning. • Fluorescent lamp, motor or electrical appliance with thermostat may be in use in or near the house. 	If it often very difficult to remove the cause of the noise. However, in order to raise the level of the input signals above the noise level, set up a good FM antenna outside and make a complete grounding.
Sound is distorted and separation is downgraded even though the broadcasting station is nearby.	<ul style="list-style-type: none"> • There may be a TV/FM community antenna in use in the building. This is causing mismatching in the antenna input. • The radio signals are too strong. • The radio signals are being multipath-reflected. 	Check the distributor and attain the correct matching. Insert an attenuator into the antenna. Vary the location and direction of the antenna to find where there is least distortion (refer to "FM MULTIPATH DISTORTION" on page 6).
When you start to receive broadcasts, there is a humming sound or a "zzzzz."	<ul style="list-style-type: none"> • Ignition noise generated from automobile engines. • A high-frequency sewing machine or welding set is being used in the vicinity. 	In an area surrounded by hills, mountains or high buildings or in an area which is distant from the broadcasting station, the FM input signals will be weak and so the tuner's built-in noise control circuit (limiter) will not work and the noise will increase. Stop using the simple antenna and set up an FM outdoor antenna having a great many director elements.
The amount of noise is higher when listening to an FM stereo program than when listening to a mono broadcast.	<ul style="list-style-type: none"> • This is because with FM stereo broadcasts the service area is about half that of ordinary mono broadcasts. 	In order to increase the antenna input of the radio signals, erect an exclusive FM outdoor antenna when listening with the indoor T-type antenna.

EIA STANDARD RACK MOUNTING

If you use the optional JA-R101 rack-mounting adaptor, you will be able to convert the dimensions of the tuner's front panel to the standard mounting dimensions which are accommodated by an EIA standard rack, and mount the tuner in a rack conforming to EIA standards. When mounting the adaptor on the tuner, transfer the four feet underneath the tuner to the recessed sections on the bottom panel (see figure).



SPECIFICATIONS

Semiconductors

ICs	21
FETs	10
Transistors	63
Diodes	56

FM Section

Unusable Sensitivity	MONO: 10.3dBf (1.8μV)
50dB Quieting Sensitivity . .	MONO: 14.1dBf (2.8μV) STEREO: 36dBf (35μV)

Signal-to-Noise Ratio

at 85dBf	MONO: 84dB
	STEREO: 81dB

Distortion at 65dBf

	WIDE	NARROW
MONO:		
100Hz	0.05%	—
1kHz	0.04%	0.08%
6kHz	0.06%	—
STEREO:		
100Hz	0.06%	—
1kHz	0.05%	0.15%
6kHz	0.05%	—

Capture Ratio

Capture Ratio	0.8dB
Alternate Channel Selectivity	
400kHz	35dB
300kHz	— 65dB

Stereo Separation

1kHz	55dB
20Hz to 15kHz . . .	40dB

Frequency Response

Frequency Response 20Hz to 15kHz $^{+0.1}_{-0.3}$ dB

Spurious Response Ratio

Spurious Response Ratio . . . 120dB

Image Response Ratio

Image Response Ratio 120dB

IF Response Ratio

IF Response Ratio. 120dB

AM Suppression Ratio

at 65dBf 65dB

Muting Threshold

Muting Threshold 19.2dBf (5μV)

Subcarrier Product Ratio

Subcarrier Product Ratio . . . 75dB

SCA Rejection Ratio

SCA Rejection Ratio 65dB

Antenna Input

Antenna Input 300-ohms balanced
75-ohms unbalanced

75-ohms coaxial ("F" type connector)

Audio Section

Output (Level/Impedance)

FM (100% MOD.) FIXED; 650mV/2.2kΩ
VARIABLE; 50mV to
1.3V/3kΩ

Miscellaneous

Power Requirements	AC110V, 120V, 220V and 240V (switchable) 50/60Hz
Power Consumption	24W
Dimensions	420(W)x156(H)x376(D) mm 16-9/16x6-1/8x14-13/16 in

Weight

Without Package	9kg (19 lb 14 oz)
With Package	10.1 kg (22 lb 4 oz)

Furnished Parts

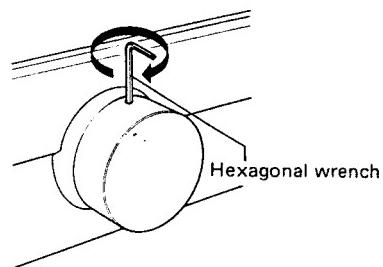
FM T-type antenna	1
Operating Instructions	1
Connection Cord with Pin Plugs	1
Hex. Wrench (used for fastening Tuning knob)	1
F type plug (for RG59U use)	1
Fuses	0.5A; 1, 1A; 1

NOTE:

Specifications and the design subject to possible modification without notice.

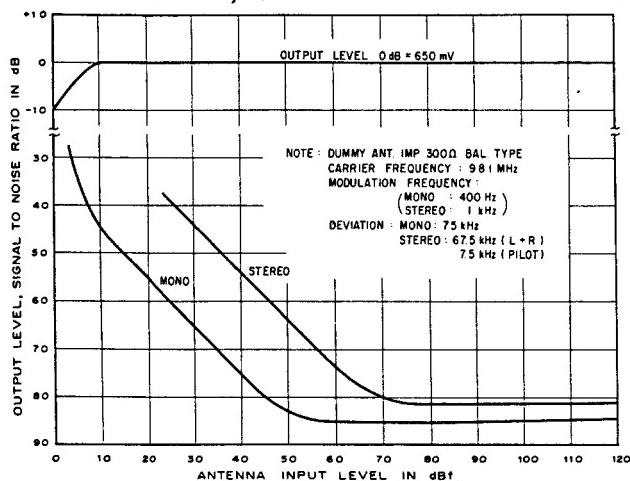
USING THE HEXAGONAL WRENCH

If the tuning knob has worked itself loose, tighten it up using the accessory hexagonal wrench.

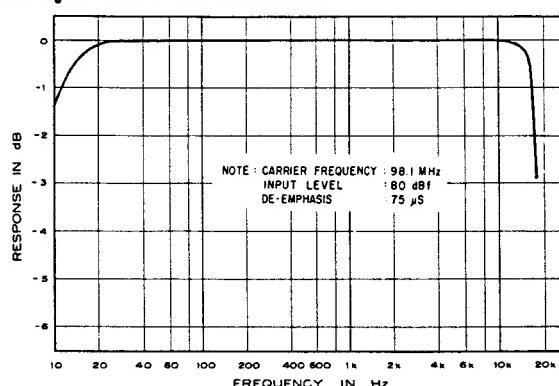


CHARACTERISTICS CHARTS

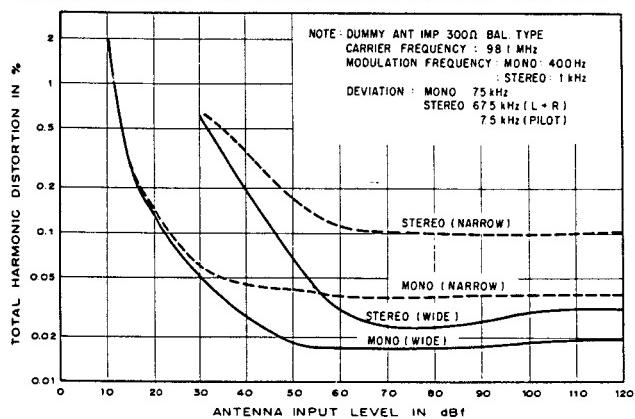
OUTPUT LEVEL, S/N vs. ANTENNA INPUT LEVEL



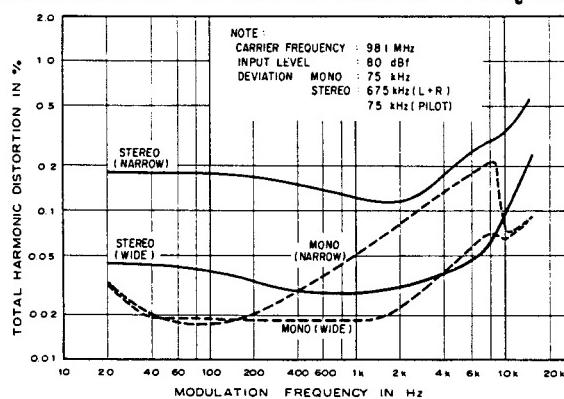
FREQUENCY RESPONSE



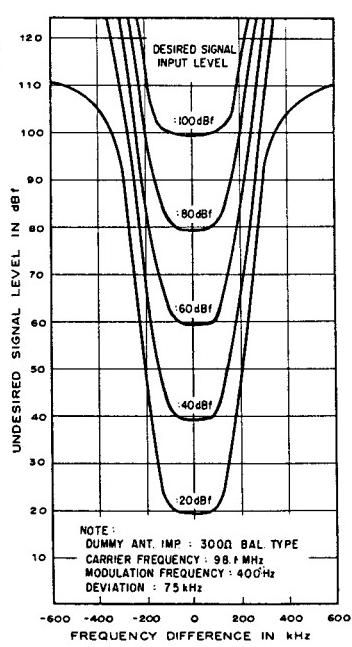
DISTORTION vs. ANTENNA INPUT LEVEL



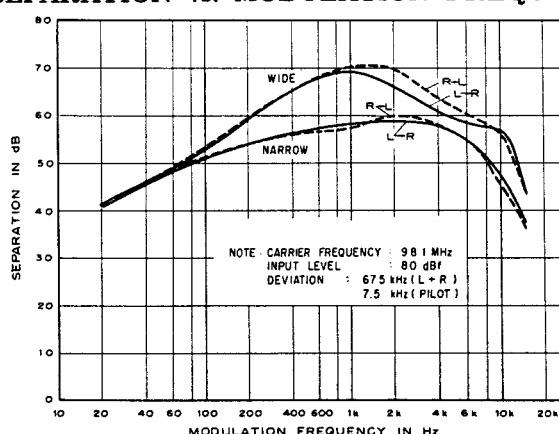
DISTORTION vs. MODULATION FREQUENCY



EFFECTIVE SELECTIVITY



SEPARATION vs. MODULATION FREQUENCY



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